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SENATE COMMITTEE
ON ARMED SERVICES

TESTIMONY OF

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Introduction

Mr. Chairman, Members of the committee, thank you for the opportunity to appear before you today. It is a pleasure to have the opportunity to testify about the science and technology program of the Department of Defense, and express our belief that science and technology is the engine that will drive the transformation of the Department. I'd like to start with a thank you to this committee and the Congress for your continued support to the Department of Defense science and technology program. Your continued push for a flexible approach to providing operators access to technology has been met with a corresponding change to the acquisition policies and regulations to begin to bring about rapid technology insertion throughout the DoD. Continued support for S&T complemented acquisition policy changes such as FAR part 12 and our current actions to revise the 5000 series documents to clear away some of the bureaucratic cobwebs, while getting at the fundamentals of good process management. I'd further ask that your support be continued, as it offers aspects of stability and forward planning that provides vision and purpose to the laboratories, and development activities within the Department and the many colleges, universities, and small technology houses that many times are the source of our innovations. The Department has forwarded several legislative proposals to Congress that seek to retain and expand flexibility to deploy technology to acquisition programs. The Department has forwarded to Congress two proposals on the use of "Other Transaction Authority" to extend the current authorities of the other transactions past 2004 and to expand authorities of other transactions to allow them to be used for existing systems as well as the new systems. The continued use of

other transactions provides an effective mechanism for industry and government to work together, and enhances technology transition capability.

Reflecting back on President Bush's goal to "move beyond marginal improvements—to replace existing programs with new technologies and strategies', he made technology a cornerstone in the plan to transform and modernize defense. We have taken on a similar goal within the Acquisition, Technology, and Logistics community, as one of our highlighted goals. That goal is to 'Initiate high leverage technologies to create the warfighting capabilities, systems and strategies of the future."

Well, how are we doing? Let me use this opportunity to review recent accomplishments and have a look to the future direction for Science and Technology to provide part of the answer to this question.

I'll start with a look at the S&T program, and then cover the technology transition areas. I'll address workforce concerns, and discuss how we are accelerating technology to the warfighters. I'm often asked if the war on terror has revised our focus, and I respond that it has expanded our focus, as it added missions, but did not relieve us of any other missions. Technology will allow us to confront this expansion of mission in the most expeditious and effective manner.

S&T investment

The DoD request for S&T in Fiscal Year 2004 is $10.232 Billion, or 2.69% of the overall Department of Defense request. The FY04 President's Budget Request is a very good budget request for science and technology. First, the budget request achieved greater than zero percent real growth for S&T, even compared to the combined FY03 President's Budget Request and Disaster Emergency Relief Fund. Perhaps more

significant is the overall growth in S&T investment that has occurred under the current administration. This administration inherited a legacy budget request of $7.8B in FY02. This administration has increased the budget request for S&T by nearly 25% in just two years. However, simply adding money to the S&T accounts will not, by itself, ensure transformation.

S&T and Transformation

In addition to increasing the overall budget request for S&T, we have focused the budget request on several important technologies that should enhance transformation and deliver superior military capabilities for years in the future. About 80% of all S&T dollars are aligned to enhance capability in one of Secretary Rumsfeld's six critical operational capabilities as outlined in the Quadrennial Defense Review. The six critical operational capabilities define the cornerstone of Secretary Rumsfeld's transformation, and are: protect bases of operations; deny enemy sanctuary; project and sustain US forces; enhance space operations; assure information operations; and leverage information technologies. Additionally, under the able guidance of the Honorable Ronald Sega, Director of Defense Research and Engineering (DDR&E), three broad, new cross cutting initiatives could accelerate the development of critical transformational technologies in areas that the DoD needs to address. The three areas are the National Aerospace Initiative; Energy and Power Technologies, and Surveillance and Knowledge Systems.

The Services are also investing in other high profile transformational projects. Among the major highlights are the Army Future Combat System, which is an example of combat and support vehicles and unmanned air and ground systems which will work

together as an integrated system-of-system, and Objective Force Warrior, which will decrease the equipment weight of the deployed infantry soldier from around 100 pounds to 40 pounds. The Air Force is developing enhanced precision weapons and directed energy weapons that will provide a battlefield option to deal with a threat with graduated effects. The Navy is moving rapidly to an electric force, with propulsion and electric weapons. Taken all together, the FY04 President's Budget Request for S&T represents a budget that continues to develop the technologies the US military will need to remain viable well into the 21st Century.

In addition, we have increased our investment in Defense Advanced Research Projects Agency (DARPA), the defense agency charged with conducting high-risk, high-payoff technologies, by almost ½ billion dollars a year. This additional DARPA investment is largely allocated to space technology, but in total, DARPA emphasizes research in eight strategic thrust areas. These eight areas are: counterterrorism; assured use of space; networked manned and unmanned systems; robust, self-forming networks; detect, identify, track and destroy elusive surface targets, characterization of underground structures; bio-revolution; and cognitive computing. DARPA also continues to support the technologies that have historically been at the center of DoD's capabilities: materials, microsystems, and information technology. I would like to highlight a couple of DARPA projects to give a feel of how DARPA's investment is supporting transformation of the department. The Organic Air Vehicle (OAV) unmanned aerial vehicle (UAV) is a small, man-portable UAV that can fly and hover in a battlefield. The UAV looks very much like a sombrero—and uses a large horizontal fan for moving and hovering. The UAV has been tested in 9, 15, and 21 inch version—and each can carry different payloads—from

on-board camera to chemical or bio agent detector. This "system" is being developed as a component of the Army's Future Combat System—which is the acquisition program to transform the Army. Another DARPA technology that is worth mentioning is the orbital express space demonstration—which is a demonstration of on-orbit refueling capability for space systems. The orbital express could usher in a new era in space, whereby the US uses primarily refuelable, small satellites to provide a more robust, enduring capability. While I only mention two DARPA programs, there are many, many more truly transformational technologies under development at DARPA. Additionally, DARPA is connected to the Services through several specific transformational projects—as will be described in the portion that covers technology transition.

In addition, we have increased the investment in demonstrations, primarily through Advanced Concept Technology Demonstrations, or ACTD, by almost 50% over the past two years, from $150M in FY02 to over $213M in FY04. The ACTD program was instrumental in developing and demonstrating the utility of UAVs such as the Global Hawk and Predator. The ACTD program harvests the technology developed in the Defense laboratories and industry, and integrates these technologies into demonstrations that provide a glimpse into the future. While there are over 70 ACTD projects currently underway, I would like to highlight a few. The Homeland Security ACTD provides a detachable command center to focus responders in the case of a terrorist or natural disaster. In effect, it brings the power of the traditional military command post to bear for homeland security. We all know it is expensive to launch and operate some reconnaissance satellites. The High-Altitude Airship ACTD will integrate technologies to determine if the military can also use survivable very high altitude dirigibles to

conduct many reconnaissance missions. The Active Denial Technology ACTD is demonstrating the ability of high power microwave systems to potentially control crowds—in effect, giving the military commander a non-lethal option to protect an area. I only highlight these three—but suffice it to say we could hold a hearing on the ACTD program alone. We have increased also our investment in experimentation, primarily joint experimentation, and are executing the investment through Joint Forces Command. This new investment lets the Department conduct large scale "experiments" or war games to effectively "try technology before it is bought."

I would like to take a moment to discuss the joint transformational technologies initiatives. The first is the National Aerospace Initiative (NAI). The complete initiative consists of hypersonic flight technology, affordable space launch, and enhanced on-orbit space technologies. In the FY04 budget request, the Department focused the increased investment into hypersonic technology, investing over $150M additional investment in hypersonics. We seek Congressional support for the FY04 budget request for hypersonic technology. We seek this because hypersonic technology could be truly transformative, in that, when developed, hypersonics provides the opportunity to conduct tactical strikes from a strategic distance. The NAI is the right initiative for America as we celebrate the first century of manned flight. Technology has progressed to the point where we believe that demonstrations to Mach 12 by 2012 are within reach. This would more than double any currently demonstrated system. The development of hypersonic technology could diminish vulnerability of existing systems, while potentially providing a true capability to strike so quickly that we could effectively deny enemy sanctuary anywhere in the world. Additionally, the hypersonic roadmap, developed cooperatively by DoD and NASA

provides long term potential for affordable access to space. In short, the National Aerospace Initiative is one of those technology opportunities that has the potential to capture American interest in technology, much like the race to the moon in the 1960's.

A second transformational technology thrust is Energy and Power Technologies. One of the present limiting factors to military operations is the logistics tail to provide energy to forces and systems. The energy and power technologies thrust involves a coordinated investment by all three Services and DARPA to generate, store and use power in systems ranging from microsystems to future generation electric ships. This initiative is investing in technology that could develop batteries with over five times the energy density, fuel cells that are reliable and safe to use in the battlefield; capacitors that will decrease size needed to store electricity on ships by a factor of 5-10. In short, this thrust could also truly transform the military.

The final cross cutting initiative is surveillance and knowledge systems. This initiative is fairly simple—it will develop the technologies to turn information into wisdom. Consequently, this initiative will seek to develop low cost sensors with various capabilities (such as optical, IR, acoustic, magnetic, and so forth), connect these information sources to tactical networks, route the data from tactical to strategic level, and finally, the initiative will develop technologies that can assist the decision-maker. The initiative could begin to make the vision of network centric warfare a reality.

Technology Transition

In October 2002**,** Deputy Secretary of Defense Wolfowitz rescinded several defense acquisition directives and regulations—in effect throwing approximately 250 pages of bureaucracy out the window. He directed the Department to revise the 5000

series documents to create “an acquisition policy environment that fosters efficiency, flexibility, creativity, and innovation.” In rescinding the regulations, Secretary Wolfowitz proposes to replace the 250 pages of directives with only 40 pages of interim policy and guidance. These 40 pages contain the fundamental elements of acquisition, as it were. Most significantly here, these 40 pages contain numerous references to the need to accelerate technology transition or insertion. The Secretary reaffirmed a streamlined acquisition process built around spiral and evolutionary acquisition. The key element of spiral acquisition is a process that allows the Department of Defense to field ever increasing capabilities brought about by enhanced technology without having to initiate a new acquisition program. This is a capabilities-based approach, and is consistent with Secretary Rumsfeld’s mandate to transform the DoD capabilities. The reason I begin the discussion of what the Department has specifically done to enhance technology transition is to stress that at the largest scale, the processes are being revamped and instituted that could allow much more effective technology transition. This is a cultural change, and will take time and leadership. This administration is committed to effecting such a cultural change.

Following the streamlining of the overall DoD acquisition process, the Office of the Secretary of Defense has taken several additional steps in the past year to enhance technology transition. At the organizational level, the Department has brought both technology transition programs and policy oversight under the Director, Defense Research and Engineering, who has consolidated the functions under Ms. Sue Payton, the Deputy Under Secretary of Defense for Advanced Systems and Concepts. This office executes both the Advanced Concept Technology Demonstration, a program that uses

demonstrations to allow the Department to "try before buying" technology and the Foreign Comparative Test program which overcomes the "not invented here" syndrome that occurs. Demonstrations are a cornerstone to spiral or evolutionary acquisition, and ACTDs are the flagship demonstration program. As stated previously, ACTD's assemble mature technologies from the science and technology base and accelerate the flow of technology to the operator.

Another key step to enhancing technology transition is having a means to provide incentives to any program that has to accept the new technology. Changes to programs of record carry risk. Yet the budget process can be slower than the technology process. By use of incentives, the Department can reward risk. In Secretary Rumsfeld's budget hearing this year, he demonstrated that time lag between when funding is allocated to a capability in the budget process and when the first dollar is spent is 18-24 months. This in a world where "Moore's Law" states computer capability doubles every 18 months. To break this cycle, the Department is testing three pilot projects contained in the "Quick Reaction Special Project" program. I was pleased that the FY 03 Authorization Act supported the Quick Reaction Special Projects (QRSP). The objective for QRSP is the speed of rapid technology development. Three programs structured under QRSP are complementary with the focus of developing technology at different maturity levels. These three programs are the Defense Acquisition Challenge Program, the Technology Transition Program, and the Quick Reaction Fund. All three require vetting by the acquisition, technology and warfighting community, but can fund a specific technology within the execution year. The Quick Reaction Fund, initiated in FY03, is already developing technology that could be used in current operations and is modeled after the

success of the FY02 Quick Reaction Munitions Fund. We believe the potential payoff from the Quick Reaction Special Program is very large—and have consequently added $50M more in the FY04 budget request compared to FY03. We seek continued Congressional support in the program, and seek your help in ensuring there is sufficient flexibility in the program to allow the DoD to most effectively be able to move fast to meet the needs of the Department. We request the program not be further divided or earmarked, so we can have the freedom to manage to effect change for the Department and America.

Why do we seek flexibility? In the FY 02 appropriations bill for the Defense Emergency Relief Fund, Congress identified $15 million for the Quick Reaction Munitions Fund. Two successful projects resulted from the funding. The first was the Thermobaric Hellfire Enhanced Capability that increased blast lethality in multi-room structures of the hellfire missile. Within one year, the project went from chemistry to the field at a cost of $12 million. The Low-Cost Guided Imaging Rocket (LOGIR) was the second project that is enhancing the accuracy of the unguided 2.75" "hydra" rocket used in close air-to-ground operations. The type of outcome we achieved from the Quick Reactions Munitions Fund should occur through use of the Quick Reaction Special Projects—and should effect technology transition.

Another key facet to enhancing technology transition has also come to fruition in the past year. Effective technology transition occurs when the three or four communities involved in developing and transitioning technology must be in close contact throughout the process. The communities are the technology, acquisition, operational and the logistics community. Effectively, the program manager, technologist, the end user, and

logistician must come together to provide the best possible supportable technology at the right maturity. In effect, the acquisition and operations risk is reduced and technology enhanced.

DARPA's Role with the Services

One concern I have heard since coming to the Department is most interesting—that concern is that DARPA is disconnected from the rest of the Department of Defense and supporting acquisition programs. Nothing could be further from the truth. In fact, this administration has put more money into DARPA because we are trying to change the technologies being developed within the Department, and DARPA is the most agile of our components with respect to changing program direction. But, DARPA has used this agility and entered into agreements with each of the Services to develop cutting edge technology and demonstrations. For instance, DARPA and the Army are linked, through formal agreement, to enable the development of the Army of the future with networked tactical equipment and vehicles, the Future Combat System. Additionally, DARPA and the Navy are joined, through memorandum, to develop the Hy-Fly missile—a supersonic demonstrator that is on the glide path to be an early NAI hypersonic demonstrator. Finally, there is the Unmanned Combat Aerial Vehicle (UCAV)—a system demonstration in conjunction with the Air Force. Each of these three systems—NAI, UCAV, and Hy-fly are at the nexus of critical capabilities needed by the Services—and a large programmatic change, so DARPA's agility was instrumental in meeting the need. Instead of the limited criticism that DARPA is not connected to the Services, I would turn it around and say DARPA is connected, and critical, to the transformation road maps of the Services. DARPA is in fact more critical and connected than ever.

National Defense Research Laboratories and Civilian Workforce

The decline in scientists and engineers becomes more acute when considering the production by academia of scientists and engineers who are American citizens. Simply, one can argue the US national security advantage over the past half century was fueled by the production of scientists and engineers—America has had the intellectual capital advantage. There are signs that America's advantage is eroding. It really does not matter how many of the scientists and engineers ultimately go to work for the Department of Defense—what matters is how large is the pool of quality scientists and engineers to select from. One could argue that the national defense engine of the end of the twentieth century was in part fueled by the increase in scientists and engineers produced in the US after the launch of Sputnik and the cold war. There was an excitement about science that resulted in an ample supply of scientists and engineers that would work on national security issues. The United States was able to produce stealth, the global positioning system, night vision devices, and precision weapons by this pool of scientists and engineers. The Department of Defense pioneered the development of the internet through the "ARPANET". The large capacity of scientists produced the capabilities leading to the superior military capabilities today. We believe it is time to rekindle the excitement of science and engineering as a national asset.

The Department of Defense has initiated several small programs in the FY03 and FY04 budget that we hope will begin the rekindling of imagination. Operational Joint Precision Educational Strike is a focused pilot initiative sponsored by Dr. John Hopps, the Deputy Under Secretary for Laboratories and Basic Science, to increase the interest in high school students in science and engineering; to reduce the number of college

freshmen who leave the sciences in their freshman or sophomore year; and to increase the graduate fellowships in science and engineering. The Department has adopted the Northwestern University's Materials World Module pilot to develop interesting, challenging modules to capture middle and high school student's imagination. We are expanding upon the module by extending the opportunity of middle and high school teachers to train and intern at DoD laboratories. The kickoff for this effort will occur at the end of this month at Picatinny Arsenal, New Jersey.

These initiatives supplement the on-going Department of Defense Basic Research program. The FY04 President's Budget Request for Basic Research is $1.3B dollars, of which over 50% goes directly to universities. We estimate that every $1M of university research supports between 10-15 graduate students, who work in areas of interest to the Department. Clearly, the DoD is putting pieces into place to attempt to generate more scientists and engineers.

At the broader strategic level, the Department is becoming concerned with the overall production of scientists and engineers available to work on national security issues. This challenge facing America is greater than an issue just for the Department of Defense. In December 2002, the National Science Foundation issued a report called "Science and Engineering Doctorate Awards 2001." This report provides the overall production of scientists and engineers in US universities. Over the past decade, the total number of Ph. D.-level scientist and engineers produced by US universities has declined.

Combating Terrorism

Within a week of the terrible attacks of September 11, the Department had established the "DoD Combating Terrorism Technology Task Force". This Task Force is

still on-going, and meets as needed to address specific technology opportunities and or needs. The Task Force is comprised of executive level technology members from all DoD Components, flag-level officers from the Joint Staff and selected Combatant Commanders, the Central Intelligence Agency, the Department of Energy, and now the Department of Homeland Security.

Phase I lasted roughly from September 2001 through Winter 2002. This phase resulted in such capabilities as the GBU-118 "Thermobaric Bomb," a backscatter gamma ray system to inspect cargo without going into the container; a small chemical detector, called the nuclear quadripole resonance system, that can detect small quantities of explosives remotely, We also used the Task Force to commission a rapid study to determine radiation levels needed to kill anthrax spores—knowledge that helped the government have an option for dealing with the anthrax scare of late 2001.

What is significant about Phase I of the Task Force is not the specific technologies—but the fact that when the Department needed new capabilities, the continued investment in technology development over the past decades had put technologies "in the cupboard" when needed. I think this is a very important point for technology and transformation. Good technology development is largely achieved through long-term, stable investment in technologies. Not every technology needs to be transitioned immediately. The technologies can be developed and stored in a near ready state until needed. But without the continued stable long-term investment, the "cupboard could be bare." The FY04 President's Budget does focus on transformation technologies. But it also maintains long-term technology based investment in such capability areas as

materials and nanotechnology, electronics, sensors, and so forth. The balance has been, and remains important.

The Task Force met only periodically throughout the Spring and early summer of 2002—but began to accelerate again when the national focus expanded to weapons of mass destruction. During Phase II of the DoD Combating Terrorism Task Force, the focus has been on technologies to detect and neutralize chemical and biological agents. The Task Force has worked primarily with both the Central Command and Special Operations Command. Specific details are still classified, but may be provided in an appropriate forum.

Conclusion

In closing, the science and technology program and the objective of Secretary Rumsfeld to provide transformational capabilities to the DoD are absolutely intertwined. I am pleased to be able to detail just a few successes of the DoD S&T program. But, throughout the technology program of the Department, and the priorities of the DDR&E, a theme emerges I believe the successes being built by the Department of Defense in technology, technology transition and transformation are very significant, and I appreciate the opportunity to come before you today to tell you about them. Thank you.